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ABSTRACT

A letter and a questionnaire (provided in appendixes) were mailed to 122 2-year colleges in the North Central Accrediting region in an attempt to identify the common denominators and institutional differences related to the general education mathematics program in the 2-year college. Of 96 questionnaires returned, 86 were included in the study. The data obtained are provided in 11 tables. Analysis of the data showed that 34 percent of the colleges required all students to take at least one mathematics course; 41 percent required either science or mathematics; and 25 percent had no mathematics category. Students were allowed a choice of several mathematics courses in 66 of the colleges, and, except for noncredit arithmetic or a basic mathematics course, all mathematics courses met requirements for the Associate degree. Fifty-nine of the colleges believed that their general education mathematics program was meeting the needs of their students; 93 percent felt that students should have options in meeting the general education mathematics requirements. The lecture method was the most commonly mentioned instruction method; most schools used, however, a variety of teaching techniques. Topics listed by more than 50 percent as being appropriate for a general-education mathematics course were: elementary algebra, graphs, probability and statistics, set theory, logic, intuitive geometry, functions, history of mathematics, and number bases. A statistically significant correlation was found between the number of nonlecture teaching techniques employed and the feeling that the students' needs were being met. Mathematics mini-courses appear to offer one solution to the problem of providing a relevant general education course. (DB)

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AN ANALYSIS OF GENERAL EDUCATION MATHEMATICS PROGRAMS IN TWO-YEAR COLLEGES

A Research Report

by

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September, 1974

JC 740 297

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INTRODUCTION

Monroe has defined general education as "that part of the college curriculum which is deemed essential for the education of all students and, therefore, should be required of all for graduation" (6, 67).

Carlin, in reviewing the future of general education, concludes:

> I would say that while the future of general and liberal education and indeed of the entire undergraduate program as a distinguishable part of the American educational system remains in the balance, the indications are good that both will not only survive but will become increasingly recognized as significant and important parts of the American educational enterprise. This implies change, of course . . . . In a world where change occurs at an accelerating rate . . . no component of American education can remain static (1, 67).

Just as Carlin predicted change, so does Morse when he says, "General education has a varying content, drawn from many sources, suited to the individual, and adjusted to the times" (7, 9).

Interest in whether the general education mathematics programs in community colleges were "changing" and "adjusted to the times" led this writer to investigate those programs.

PROBLEM

The focus of this study is the general education mathematics program in the community college.

Specific questions this investigation sought to answer were:

1. Is it necessary for students to complete a mathematics course to meet the general education requirements?

2. Do the students have any options in the selection of a general education mathematics course?

3. Does the course content of the general education mathematics course(s) differ from that of the high school courses?

4. What are the most frequently employed instructional techniques used in teaching a general education mathematics course?

5. What criteria are used for selection of the general education mathematics instructor?

6. What mathematical topics are most appropriate for the general education mathematics course?

PROCEDURES

A letter (Appendix A) and questionnaire (Appendix B) were mailed to a total of 122 two-year colleges in the North Central Accrediting region. Every third school in the North Central region as listed in the 1973 Directory of the American Association of Junior Colleges was selected for this study. The chairperson of the mathematics department was asked to complete the questionnaire and return it. A total of 96 questionnaires were returned. Of these, ten schools replied that they did not have a general education mathematics program and accordingly did not complete the questionnaire. Thus, a total of 86 completed questionnaires were used in this study.

FINDINGS

The 86 schools represented all sizes of two-year colleges. The smallest college had an enrollment of 29 students, the largest, 15,000 students. Table I indicates the number of colleges represented in each of the various enrollment categories.

Table I

Number of Colleges by Enrollment
(Number Responding = 86)

Enrollment	Number of Colleges
Fewer than 200	8
201 - 600	27
601 - 1,200	19
1,201 - 4,000	18
4,001 -15,000	10
No reply	4

Mathematics may play any one of several roles in the general education requirements. Approximately 34 percent of the colleges responding require mathematics for those students desiring an Associate degree. Another 41 percent of the colleges require that students take either a mathematics or science course. Approximately one-fourth of the colleges responding require no mathematics. Table II gives a summary of the responses.

Table II

Mathematics' Role in General Education Requirements
(Number Responding = 85)

Role	Number of Colleges	Percent
Mathematics required	29	34
Mathematics or science required	35	41
No mathematics required	21	25

Two-year college students do have some flexibility and freedom in meeting their general education mathematics requirements. More than three-fourths of the colleges indicated that their students had a choice of several courses. Only 13 percent of the colleges had only one mathematics course available to satisfy the general education requirements. Of the five colleges in the "others" category, four indicated that the students' specific program determined the course to be taken. The other college allowed students to meet the requirement by passing a proficiency examination. Table III summarizes these data.

Table III

Alternatives to Meet General Education Requirements
(Number Responding = 84)

Method	Number of Colleges*	Percent
Choice of several courses	66	79
Only one course available	11	13
Student is tested and placed in appropriate course	23	27
Others	5	6

*Number of colleges does not total 84 since some colleges listed more than one method. For the same reason, the sum of the percentages is greater than 100.

Analysis of these data indicated that almost all mathematics courses offered in the two-year college curriculum can be applied to meet the general education requirement in mathematics. For the mathematics major, calculus, linear algebra, and other courses found in the usual college mathematics sequence can be used to meet this requirement. For the non-mathematics major, arithmetic, algebra or trigonometry were commonly mentioned as courses which met the general education requirement. Several schools offered a remedial non-credit arithmetic course and did not allow a student to fulfill his mathematics requirements with such a course. In addition to these options, over half of the colleges offered a mathematics survey course. Approximately one-fourth of the colleges offered the block and gap type of course

where several topics were studied in depth and others were ignored. Only 28 percent of the colleges tested the student and then prescribed a program best suited to the needs of the student. As the data in Table IV show, 22 colleges have indicated other types of programs. "Basic math concepts for elementary teachers," and "varies with the program," were two of the most frequent replies to this item.

Table IV

Type of Mathematics Program Available to Meet the General Education Requirements (Number Responding = 83)

Type	Number of Colleges*	Percent
Survey course	47	57
Block and gap method	20	24
High school mathematics	28	34
Competency-based (test student and then prescribe a program)	23	28
Other	22	27

*Number of colleges does not total 83 since some colleges listed more than one type of program. For the same reason, the sum of the percentages is greater than 100.

The writer was interested in determining to what extent the two-year colleges deviated from the lecture approach in teaching general education mathematics courses. The data in Table V show that various other methods were employed on a regular basis. For

instance, over one-half of the colleges individualized their instruction in some manner. Programmed instruction, mini-courses, independent study, the laboratory approach and audio-tutorial programs were techniques other than the usual lecture approach that were quite popular. On the other hand, only one college offered an interdisciplinary course. Help sessions were listed under "other" by three colleges.

Table V

Teaching Techniques Employed in General Education Mathematics Classes (Number Responding = 85)

Technique	Number of Colleges*	Percent
Lecture	81	95
Individualized instruction	43	51
Programmed instruction	26	31
Laboratory approach	25	29
Independent study	19	22
Mini-courses	19	22
Audio-tutorial	15	18
Computer assisted instruction	9	11
Television	1	1
Interdisplinary studies	1	1
Other	3	4

*The total does not equal 85, since most colleges checked several methods. For the same reason, the sum of the percentages is greater than 100.

Another way of looking at the size of the institution other than enrollment would be to look at the number of instructors in the mathematics department. The data in Table VI show that 48 of the 85 colleges had either one, two, or three mathematics instructors. Eighteen colleges had departments with either four, five, or six members; the remaining nineteen colleges had seven or more instructors in the mathematics department.

Table VI

Number of Colleges by Number of Instructors in Mathematics Department (Number Responding = 85)

Number of Mathematics Instructors	Number of Colleges	Percent
One, two, or three	48	57
Four, five, or six	18	21
Seven or more	19	22

In 59 of the 85 colleges each member of the mathematics department was involved in some way with the general education mathematics courses. These data are found in Table VII.

Table VII

Number of Colleges Whose Entire Mathematics Department Is Involved in the General Education Mathematics Courses, by Number of Instructors in Department (Number Responding = 59)

Number of Mathematics Instructors	Number of Colleges
One, two, or three	36
Four, five, or six	9
Seven or more	14

The methods by which instructors were assigned to teach the general education mathematics courses (see Table VIII) were about as one would expect after studying the results presented in Table VII. About two-thirds (including colleges with only one instructor) had their entire departments teaching at least one of these courses. Approximately one-sixth of the colleges rotated these assignments. Another one-sixth of the colleges chose an instructor in the department who showed an interest in this type of mathematics course. Still another one-sixth of the colleges had only one instructor in the department and thus his assignment to the course was necessary in order for the course to be taught. Not a single college indicated that they assigned the instructor with the least seniority to teach the general education mathematics class.

Table VIII

Methods by Which Instructors Are Assigned to Teach
the General Education Mathematics Courses
(Number Responding = 85)

Method	Number of Colleges*	Percent
Rotation basis	13	15
All instructors are involved	59	69
Instructor with least seniority	0	0
Only one instructor in department	14	16
Someone that shows an interest	13	15
Other	4	5

*The total does not equal 85 since some colleges checked more than one method. For the same reason, the sum of the percentages is greater than 100.

If given a choice, most two-year college instructors would be involved in the teaching of the general education mathematics courses. In fact, 78 percent of the colleges responding to this question answered affirmatively. Twenty-two percent indicated they would prefer not to be involved.

There are many theories as to what the content of the general education mathematics course should be. For this reason, the writer asked those people nearest to the situation--the instructors--to indicate those topics they considered appropriate. Elementary algebra, graphs, probability and statistics, and logic were the most frequently suggested topics. Other topics given by more than 50 percent of the

colleges were intuitive geometry, functions, history of mathematics, and number bases. Several of the topics listed under "other" were elementary number theory, games and puzzles, and the metric system. Table IX contains the complete results to this inquiry.

Table IX

Number of Colleges Indicating the Appropriateness of Topics for the General Education Mathematics Course (Number Responding = 85)

Topic	Number of Colleges*	Percent
Elementary algebra	73	86
Graphs	63	74
Probability and statistics	62	73
Set theory	62	73
Logic	58	68
Intuitive geometry	55	65
Functions	50	59
History of mathematics	44	52
Number bases	43	51
Systems of equations	40	47
Trigonometry	35	41
Matrices and determinants	29	34
Finite mathematical systems	26	31
Logarithms	26	31
Slide rule	19	22
Vectors	18	21
Complex numbers	14	16
Elementary topology	10	12
Computer programming	3	4
Other	8	9

*The total does not equal 85, since most colleges checked several topics. For the same reason, the sum of the percentages is greater than 100.

The mathematics department chairperson was asked to agree or disagree with the statement: "The general education mathematics courses meet the needs of the students." While 59 of the 86 chairpersons agreed with the statement, the other 27 (33 percent) chairpersons either had no opinion or disagreed with the statement (see Table X). This would indicate that some sort of change in program is acknowledged as necessary for the schools to have a relevant and meaningful general education mathematics program.

Table X

Response to the Statement: "The General Education Mathematics Courses Meet the Needs of the Students" (Number Responding = 86)

Response	Number of Colleges	Percent
Strongly agree	10	12
Agree	49	57
No opinion	9	10
Disagree	18	21
Strongly disagree	0	0

The mathematics department chairpersons were almost unanimous in their agreement with the statement: "Students should have options or choices available to meet the general education mathematics requirement." Approximately 93 percent either strongly agreed (55 percent) or agreed (38 percent) with the statement (Table XI).

Table XI

Response to the Statement: "Students Should Have Options or Choices Available to Meet the General Education Mathematics Requirement" (Number Responding = 86)

Response	Number of Colleges	Percent
Strongly agree	47	55
Agree	33	38
No opinion	2	2
Disagree	3	4
Strongly disagree	1	1

An interesting and statistically significant result was found when analyzing the non-lecture teaching technique. The college chairpersons were asked to indicate the degree to which they agreed with the statement: "The general education mathematics courses meet the needs of the students." Also tabulated were the number of non-lecture teaching techniques employed in their general education mathematics classes. A significant correlation, beyond the 0.02 level ($r = 26$; $df = 83$), was found to exist between the number of non-lecture teaching techniques employed in the general education mathematics courses and the feeling that the students' needs were being met in these courses.

There was also a strong relationship ($r = .19$; $df = 83$) between those colleges offering mini-courses and the chairpersons' indication of meeting the needs of their students in the general education

mathematics program. While this relationship was not statistically significant ($p < .10$), it is interesting to note that only one of the 18 (5.6 percent) colleges offering mini-courses felt that they were not meeting the needs of their general education mathematics students. On the other hand 16 of the 67 (23.9 percent) colleges not offering mini-courses felt that their students' needs were not being met.

SUMMARY OF FINDINGS

This study of the general education mathematics program in two-year colleges was begun in the fall of 1973 and concluded in the spring, 1974. A questionnaire relating to the general education mathematics program was sent to 122 two-year colleges. These colleges in the North Central Accrediting region were randomly selected from the Directory of the American Association of Junior Colleges, 1973. Eighty-six colleges returned completed questionnaires and constituted the sample for this study.

Thirty-four percent of these colleges required that all students take at least one mathematics course. Another 41 percent of the colleges had a general education requirement that could be satisfied by either science or mathematics. The remaining 25 percent had no mathematics category. Nearly four-fifths (66) of the responding colleges allowed their students a choice of several courses when selecting a mathematics course to meet the general education requirements. Except for the non-credit arithmetic or basic mathematics course, all mathematics courses met the requirements for the Associate degree.

Fifty-nine of the 86 colleges believed that their general education mathematics program was meeting the needs of their students. The other 27 colleges either had no opinion or felt that their students' needs were not being met. Almost all colleges (93 percent) felt that students should have options available to meet the general education mathematics requirements.

A variety of teaching techniques was employed by the instructors in the general education mathematics courses. The lecture method of instruction was by far the most commonly mentioned method. Over 95 percent of the colleges made use of the lecture method. Most schools, however, used a variety of teaching techniques in their general education mathematics courses. Just over half of the colleges had implemented some form of individualized instruction. The various teaching techniques and the percentage of the responding colleges employing these techniques were: lecture (95 percent), individualized instruction (51 percent), independent study (22 percent), audio-tutorial (18 percent), computer assisted instruction (11 percent), team teaching (5 percent), television 1 percent), and interdisciplinary studies (1 percent).

The following topics were listed by more than 50 percent of the colleges as being appropriate for a general education mathematics course: elementary algebra, graphs, probability and statistics, set theory, logic, intuitive geometry, functions, history of mathematics, and number bases.

A statistically significant correlation (beyond the 0.02 level) was found to exist between the number of non-lecture teaching techniques

employed in the general education mathematics courses and the feeling that the students' needs were being met in these courses. Though not statistically significant ($p < .10$) there also was a strong relationship between those colleges offering mini-courses and their indication of meeting the needs of their students.

More than three-fourths of the colleges indicated a desire by their mathematics faculty to be involved in the general education program. Fifty-nine of the 86 colleges indicated that all of their mathematics instructors were involved in the general education program. The remaining 27 colleges were evenly divided between making these teaching assignments on a rotation basis or by choosing an interested mathematics instructor.

RECOMMENDATIONS

"Every student at the college level should have a working knowledge and an understanding of the language of mathematics. To be entirely cut off from this medium of communication is to be less than an educated person" (1, 65). Thus it is imperative that two-year colleges adequately prepare their students in mathematics.

A first step toward producing an "educated person" might be to assess his entry-level mathematical abilities. The National Council of Teachers of Mathematics commissioned the Committee on Basic Mathematical Competencies to identify those competencies and skills essential for enlightened citizens (3, 671). These competencies and skills could serve as a guide in diagnosing the students' mathematical

needs. A test such as The Beckmann-Beal Mathematical Competencies Test for Enlightened Citizens might be very useful in an endeavor of this nature.

Those students scoring below the school's level of acceptance would then be required to work on an individualized mathematics program. This program would be designed to allow a student to master those skills not originally demonstrated.

Upon completing this program a student would enter the general education mathematics program. Monroe, discussing the role general education plays in the total curriculum, said, "If general education is to survive as a vital part of the total curriculum, it must be made relevant to the needs of modern man" (6, 77). Thus this question is posed: "What mathematical topics are relevent to the two-year college student?" In a survey of 86 two-year colleges in the North Central Association of Colleges and Universities, the author found that more than 50 percent of the colleges listed these topics as being appropriate for a general education mathematics course: elementary algebra, graphs, probability and statistics, set theory, logic, intuitive geometry, functions, history of mathematics, and number bases. Mitchell feels that exposing all students to each of these topics is not the answer: "The current topics of general education mathematics witness that many varied areas of mathematics are accessible to those with only the most elementary preparation. Moreover, the profusion of topics testifies that it is impractical to attempt to survey the entire realm of mathematics in a single course.

Yet the variety of students in a course guarantees that no single topic is likely to be relevant to all" (5, 35).

There is a growing concern that the cultural and historical emphasis of the early general education movement is no longer a reality (5, 33). If a college feels that all students need to understand and appreciate "what mathematics is" they might require a History of Mathematics mini-course.

Because of the strong relationship between those colleges offering mini-courses and their indication of meeting the needs of their students, the offering of mathematics mini-courses seems to be one solution to the problem of providing a relevant general education course. Nineteen of the 86 colleges in the sample of this study currently offered mini-courses. Barton County (Kansas) Community Junior College had been offering mini-courses for approximately four years (8, 36). Their mathematics department developed a variety of short courses which were taught for a five-week period and carried one hour of credit. These mini-courses met for 150 minutes each week. The student, with the help of his advisor, would enroll in those mini-courses that were most closely related to his intended major or career choice. The following examples of possible short course selections illustrate the flexibility available to the students (2, 37).

Elementary Education Major	Psychology Major
Geometry	Graphs
Finite Mathematical Systems	Probability
Number Bases	Statistics
Logic	

Automotive Science Major

Equation Solving
Logarithms and Slide Rule
College Arithmetic

In addition to creating a more meaningful program to meet the needs of the student, there are several other benefits of a program as has just been described.

1. The instructor could presumably teach those mini-courses he is really interested in or those for which he is best prepared.

2. The student may have the opportunity of working with each member of the mathematics department.

3. The student's semester load can be easily adjusted. Instead of having a choice of carrying 15 or 18 hours, a student could choose to take 16 or 17 hours by adding either one or two mini-courses.

4. A student could add a course during a semester--either at the end of five weeks or ten weeks. This is especially important if a student has had to drop a course during the early part of a semester.

5. The student's interest may be maintained more easily since he is enrolled in a short course.

According to G. Robert Darnes, "One of the unusual and distinctive features of the comprehensive junior college is its willingness and ability to provide both facilities and instruction for varied subject matter for students with a wide range of academic ability as well as social and economic background" (4, 61). The mathematics mini-course is such a method of instruction.

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APPENDIX A

Cover Letter

THE UNIVERSITY OF NEBRASKA-LINCOLN
LINCOLN, NEBRASKA 68508

TEACHERS COLLEGE
DEPARTMENT OF
SECONDARY EDUCATION

Dear Chairperson:

The University of Nebraska at Lincoln is sponsoring a study focusing on the general education (group requirements) mathematics programs in the two-year colleges within the North Central Accrediting region.

As you know, much controversy and indecision surround this issue, prompting a multitude of approaches. It is the intent of this study to identify the (a) common denominators, and (b) institutional differences as they relate to the general education mathematics program in the two-year college.

The enclosed questionnaire will take about 15 minutes to complete. Since the validity of the results depends greatly upon the number of responses, we hope you will be able to fit it into your schedule. Should you wish an abstract of the report of the study, there is a space on the bottom of the third page of the questionnaire for you to so indicate.

Thank you for your cooperation in this study.

Sincerely,

/s/ Udo H. Jansen

Udo H. Jansen
Professor

/s/ Charles D. Friesen

Charles D. Friesen
Instructor

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Enclosure

APPENDIX B

Questionnaire

A Survey of General Education Mathematics Programs

Instructions: In answering this questionnaire please keep in mind that the questions relate only to your institution's requirements, courses, teaching methods, and instructors. You may check more than one choice should you find it necessary to do so.

1. All students may meet a general education requirement in the area of:

   _____A. Mathematics (____semester hours)
   _____B. Mathematics and/or science (at least ____ hours in math)
   _____C. No mathematics required
   _____D. Another area which includes math (specify)_____

2. If a mathematics course(s) satisfies a general education requirement, check the method(s) by which the student may meet this requirement:

   _____A. Choice of several courses
   _____B. Only one course available
   _____C. Student is tested and placed in appropriate course(s)
   _____D. Other (specify) _____

3. Check the categories below which describe the type of program available to meet the general education requirements:

   _____A. Survey course
   _____B. Block and gap method (several topics studied in depth, others not covered)
   _____C. High school mathematics (arithmetic, algebra, geometry)
   _____D. Competency based (test student and then prescribe a program)
   _____E. Other (specify)_____

4. In column one check those courses offered at your school that enable a student to meet the general education requirements. In column two check to indicate those courses that receive transfer credit. In column three indicate the semester or quarter hours assigned each course. Underline the appropriate designation in column three (semester or quarter).

		Meets General Ed. Requirement	Transfer Credit	Sem/Qtr Hours
A.	Arithmetic (Basic Math)	_____	_____	_____
B.	Tech. or Business Math	_____	_____	_____
C.	Algebra I	_____	_____	_____
D.	Euclidean Geometry	_____	_____	_____
E.	Intermediate Algebra	_____	_____	_____
F.	Trigonometry	_____	_____	_____
G.	Analytical Geometry	_____	_____	_____
H.	Calculus	_____	_____	_____
I.	Other (specify) _____	_____	_____	_____
J.	Other (specify) _____	_____	_____	_____

5. Check those teaching techniques that best describe the method(s) of instruction as found in the general education mathematics classes. To check an item indicates that it is frequently employed.

_____A. Programmed instruction

_____B. TV

_____C. Audio-tutorial

_____D. Mini-courses

_____E. Individualized instruction

_____F. Independent study

_____G. Team teaching

_____H. Interdisciplinary studies

_____I. Laboratory approach

_____J. Computer assisted instruction

_____K. Lecture

_____L. Other (specify)

_____

6. How many instructors have teaching assignments in the mathematics department? _____

How many of these instructors are assigned teaching responsibilities in the general education mathematics program? _____

7. How is the assignment of instructors for the general education courses in mathematics made?

_____A. Rotation basis

_____B. All instructors are involved

_____C. Instructor with least seniority

_____D. Only one instructor in department

_____E. Someone that shows an interest

_____F. Other (specify) _____

8. In your opinion, if the instructor(s) of the general education mathematics courses had a choice as to teaching assignment, would they be teaching those courses? _____

9. Check those topics you would consider appropriate for the general education mathematics course. Add other topics that you feel should be included in a course of this nature.

_____ Elementary algebra

_____ Intuitive geometry

_____ Number bases

_____ Logic

_____ Logarithms

_____ Slide rule

_____ Trigonometry

_____ Probability & statistics

_____ History of math

_____ Set theory

_____ Systems of equations

_____ Matrices & determinants

_____ Finite math systems

_____ Elementary topology

_____ Vectors

_____ Complex numbers

_____ Functions

_____ Graphs

_____

_____

Average Annual Enrollment

	Institution Enrollment	General Education math courses
Freshman	_____	_____
Sophomores	_____	_____
Total	_____	_____

Indicate the extent to which you agree with these statements:

11. "The general education mathematics courses meet the needs of the students."

Strongly agree _____ Agree _____ No opinion _____

Disagree _____ Strongly disagree _____

12. "Students should have options or choices available to meet the general education mathematics requirement."

Strongly agree _____ Agree _____ No opinion _____

Disagree _____ Strongly disagree _____

13. Please feel free to include any additional information relating to your general education mathematics program. Use the back side of this page.

Thank you for completing this questionnaire. If you would like a copy of the results of this investigation, please check _____.

Signature _____
Institution _____
City _____
State _____
Zip code _____

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